AP Biology Population Problems

Name _____ Pd. _____

A. Population Growth Equation Review

$dN/dt = B - D$ used for population growth rate problems, not individual (per capita) rates.

$dN/dt = r_{max}N$ used for individual (per capita) rates <u>without carrying capacity</u> (exponential growth)

The 2 above equations can be set equal if needed.

A population of deer has 3000 individuals. There are 400 births and 150 deaths in one month.

a. Calculate the population growth rate for 1 month.

**B-D** = 400/month – 150/month = r = **<u>250 individuals per month</u>**.

b. Calculate the per capita growth rate for 1 month.

$B - D = r_{max}N \quad = 250 = r_{max}(3000)$

$r_{max}$ = **<u>0.083 new individuals per current individual per month</u>**

Immigrations are summed with births, emigrations are summed with deaths.

1. A population of squirrels has 2500 individuals. There are 106 births, 29 deaths and 40 new members entered the populations in 1 year.

a. Calculate the population growth rate for 1 year.

b. Calculate the per capita growth rate for 1 year.

c. Assuming the per capita growth rate remains the same, how many members of the population will there be after 3 years?

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$dN/dt = r_{max}N (K-N/K)$ used for individual (per capita) rates <u>with carrying capacity</u> (logistic growth)

2. A population of zebra exhibits logistic growth with a carrying capacity of 400 and consists of 300 zebra. In one year there are 100 births and 45 deaths.

a. What is the per capita growth rate for 1 year?

b. What is the population growth rate for 1 year?

c. Starting with the initial population of 300 zebra, graph the population size over time for a time interval of 8 years. Explain how the shape of the curve relates to "K"

3. A population of butterflies of 435 members has a per capita growth rate of .28 and in 1 year, 27 butterflies died. What was the birth rate?

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4. Two populations, let's say "A" & "B", have the following data after 1 generation of observations. Fill in the remainder of the table.

| | B - D | N | $r_{max}$ | K |
|---|---|---|---|---|
| Population A | 20,000 | | .22 | N/A |
| Population B | 30 | | .22 | N/A |

Fill in the table below showing N at the start of each generation.

| Generation | Population A | Population B |
|---|---|---|
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

a. What type of growth is exhibited by population A? Population B?

b. Could these 2 populations be of the same species? Explain.

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5. Assume the same information from # 4 on the previous page. However, a change in the environment now imposes a carrying capacity on both populations: Population A, K = 45,000 & Population B, K = 380. Using the generation 6 data, continue the table below:

| Generation | Population A | Population B |
|---|---|---|
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |

a. Construct a graph to show the data for population A over the 11 generations of data.

b. Construct a graph to show the data for population B over the 11 generations of data.

* Be sure to use graph paper & make the graphs **NEAT** with titles, labels, etc.

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5. Repeat the calculations using the same starting values at generation 1 for populations A & B, except complete the table imposing the K values for all generations.

| Generation | Population A | Population B |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |

a. Construct a graph to show the data for population A over the 11 generations of data.

b. Construct a graph to show the data for population B over the 11 generations of data.

* Be sure to use graph paper & make the graphs **NEAT** with titles, labels, etc.

6. Compare & contrast the growth among populations A & B without "K"

7. Compare & contrast the growth among populations A & B when "K" suddenly occurs.

8. Compare & contrast the growth among populations A & B when "K" is always imposed.

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9. Analyze how the effects of “K” differ according to when it is imposed.

10. Identify 1 species for which “K” is usually not a factor.

11. Predict a scenario in which “K” would become a factor for your chosen species.

12. Identify a species in which “K” is usually imposed.

13. Predict a scenario in which “K” would not be a factor for your chosen species.